

**DATA QUALITY SUMMARY REPORT FOR
ORGANIC CARBON/ELEMENTAL CARBON DATA
COLLECTED BY SONOMA TECHNOLOGY, INC.,
DURING THE CALIFORNIA REGIONAL PM₁₀/PM_{2.5}
AIR QUALITY STUDY**

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1. INTRODUCTION AND OBJECTIVES

The purpose of this Data Quality Summary Report is to provide data users with an understanding of the quality of PM_{2.5} organic carbon/elemental carbon (OCEC) data collected by Sonoma Technology, Inc. (STI) for the California Regional PM₁₀/PM_{2.5} Air Quality Study (CRPAQS). **Table K-1** summarizes the operating sites and times for OCEC concentration measurements during CRPAQS. This report provides summary information on data completeness, lower quantifiable limit (LQL), accuracy, and precision. The OCEC instrument measured PM_{2.5} OC and the combined OC+EC concentrations with 60-minute resolution in standard temperature and pressure ($\mu\text{g}/\text{m}^3$ STP). Data completeness was calculated for all sites based on data delivered to ARB; the start date/time indicates the beginning of valid data, continuous until the stop date/time. Data validation suggested that all OCEC instruments performed similarly; thus, Angiola was used as a representative site to calculate LQL, accuracy, and precision for all OCEC monitors operated by STI in the study.

At the Angiola site, part way through the study period, the operating parameters were changed (e.g., instrument temperature and burn times). These changes influence the validity of the data and are further described in Hafner et al. (2003). The date and time of this change is identified in Table K-1, differentiated by method code A or B.

Table K-1. Location and duration of OCEC measurements performed by STI during CRPAQS.

Site	Start Date/Time	Stop Date/Time
Angiola Trailer Method B	2/23/00 7:00 PST	11/2/00 23:00 PST
Angiola Trailer Method A	11/3/00 0:00 PST	2/9/01 23:00 PST
Bakersfield	10/4/00 11:00 PST	2/9/01 23:00 PST

Several other documents are available from which to obtain information about the CRPAQS field study and data processing. Sampling locations are described in Wittig et al. (2003). Quality control screening procedures are summarized by Hafner et al. (2003). Results of systems and performance audits and intercomparisons are provided by Bush et al. (2001).

No data quality objectives (DQOs) were available for the OCEC measurements.

2. DATA COMPLETENESS

Data completeness for 60-minute OCEC sites is shown in **Table K-2**. Data capture quantifies the percentage of total records received versus the number expected during the “period of operation” defined by the start and stop dates/times in Table K-1; the start date/time is the first instance of valid data, and the period of operation is continuous until the stop date/time. The number of valid data points is divided by the number of captured data points to calculate the data recovery. Validity is defined for this calculation as any data point that has a quality control flag

of V0 (valid) or V1 (valid but comprised wholly or partially of below-MDL data). Details of data validation are included in Hafner et al. (2003).

Table K-2. Data completeness values for OCEC data (60-minute) at each site.

Monitoring Site	Data Type	Total No. of Records	No. of Expected Records	Percent Capture ^a	No. of Valid Records	Percent Recovery ^b	No. of Suspect Records	No. of Invalid Records	No. of Missing Records
Angiola Trailer Method B	OC	6089	6089	100%	0	0%	1227	3650	1212
Angiola Trailer Method B	OC and EC	6089	6089	100%	0	0%	1227	3650	1212
Angiola Trailer Method A	OC	2376	2376	100%	2194	92%	18	99	65
Angiola Trailer Method A	OC and EC	2376	2376	100%	2195	92%	18	98	65
Bakersfield Method A	OC	3085	3085	100%	2562	83%	1	453	69
Bakersfield Method A	OC and EC	3085	3085	100%	2562	83%	1	453	69

^a % of capture = total number of records/expected records*100%

^b % recovery = number of valid records/total number of records

All sites had a 100% data capture rate. Data recovery rates were zero for Angiola Trailer Method B data. These data had different operating parameters and generally lacked documentation on instrument operation. About one-fifth of the data were flagged as suspect, another one-fifth were missing (when the instrument was off-line), and the remainder were flagged as invalid because of incorrect or abnormal instrument settings, afterburner heating problems, thermocouple failure and replacement, suspiciously low data, failed zero air calibrations, skipped cycles, and numerous instrument failures. No statistics were performed on these data to determine the LQL, accuracy, or precision. Recovery rates ranged from 83% (Bakersfield, Method A) to 92% (Angiola, Method A) for the remainder of the data.

3. LOWER QUANTIFIABLE LIMIT

The LQL is the lowest concentration in ambient air that can be measured when processing actual samples. Sources of variability that influence the monitored signal at low concentrations include instrument noise and atmospheric variability. As a measure of this variability, two times the standard deviation of selected 60-minute data was used to estimate the LQL. The selected data were collected during relatively stable periods with concentrations close to zero. This is a conservative estimate of the LQL because it includes the concentration variability of the ambient air. Six data points were used with the 60-minute data, because atmospheric variation generally becomes too great after six hours to calculate a reasonable LQL.

The LQL is calculated as shown in Equation K-1. **Table K-3** shows the 60-minute LQL, as well as the specific data strings used to calculate the LQL.

$$LQL \approx 2s = 2\sqrt{\frac{\sum (OCEC - \overline{OCEC})^2}{N - 1}} \quad (K-1)$$

where:

\overline{OCEC} = mean OC or EC concentration
N = number of measurements
 σ = standard deviation

Table K-3. Time period used to calculate LQL, the LQL, and the corresponding mean concentration during the selected time period (Method A only).

Parameter	Time Period Used in LQL Calculation	LQL ($\mu\text{g}/\text{m}^3$)	Mean ($\mu\text{g}/\text{m}^3$)
OC	12/19/00 00:00 – 06:00 PST	0.089	0.360
OC+EC	11/13/00 15:00 – 21:00 PST	0.444	0.740

4. ACCURACY

Calibration data for the OCEC instrument is not available since it cannot be calibrated in a manner similar to instruments measuring gaseous species. Validation flow checks were performed periodically on the OCEC instrument; these checks can be used to evaluate the accuracy of the flow through the instrument throughout the study. This technique quantifies the variability of the measured flow from the periodic flow checks. While not the true accuracy of the concentrations measured by the instrument, if most of the error is assumed to be due to flow changes, this method provides a sufficient surrogate.

Accuracy can be expressed in terms of the 95% confidence interval (CI). For OCEC measurements, the 95% CIs were calculated from the differences between the monitor's measured flow and the known flow provided by the flow checks. The 95% CI approximates the accuracy of the data as shown in Equation K-2.

$$\text{Accuracy} \approx 95\% \text{ confidence interval} = \frac{1.96 \left(\frac{s_{\text{flowcheck}}}{\sqrt{N}} \right)}{[\text{OCEC}]_{\text{flowcheck}}} \times 100\% \quad (\text{K-2})$$

where

$$s_{\text{flowcheck}} = \sqrt{\frac{\sum (x - \bar{x})^2}{N - 1}}$$

$$x = [\text{OCEC}]_{\text{flowcheck}} - [\text{OCEC}]_{\text{measured}}$$

$$\bar{x} = \frac{\sum ([\text{OCEC}]_{\text{flowcheck}} - [\text{OCEC}]_{\text{measured}})}{N}$$

$$[\text{OCEC}]_{\text{flowcheck}} = \text{OCEC true flow as per flow check.}$$

$$[\text{OCEC}]_{\text{measured}} = \text{flow measured during flow check by the OC/EC.}$$

Periodic flow checks were performed at all sites; Angiola is used as the representative site for all OCEC monitors operated by STI during CRAPQS. The average flow measured during flow checks, $[\text{OCEC}]_{\text{measured}}$, was calculated by averaging the measured flows during the periodic flow checks. The 95% CIs and the number of flow checks used to estimate the CIs for the OCEC at Angiola are provided in **Table K-4**.

Table K-4. Accuracy and number of flow check data points used for the OCEC at the representative site, Angiola.

No. of Flow Checks Used	Accuracy
13	2.3%

5. PRECISION

Precision can be measured for the OCEC by evaluating the variance of OC and OC+EC concentrations during a period of low variability, when atmospheric influence on variability is assumed to be minimal. Data collected during periods of low variability, but when concentrations were well above the LQL, were selected. The precision was then evaluated by calculating the coefficient of variation (CV) during the period of low variability, as shown in Equation K-3.

$$\text{Precision} \approx \text{CV} = \frac{\sigma_{\text{measured}}}{[\text{OCEC}]_{\text{measured}}} \times 100\% \quad (\text{K-3})$$

where

$$\sigma_{\text{measured}} = \sqrt{\frac{\sum ([\text{OCEC}]_{\text{measured}} - [\text{OCEC}]_{\text{measured}})^2}{N - 1}}$$

All the OC and EC concentrations in Equation 5-1 refer to the concentrations measured during the selected time period. **Table K-5** shows the precision calculated for the representative site, Angiola.

Table K-5. Precision, the number of data points, time period, and mean of the data used to calculate the precision of the OCEC data at the representative site, Angiola.

Parameter	No. of Data Points Used	Time Period	Mean ($\mu\text{g}/\text{m}^3$)	Precision ($\mu\text{g}/\text{m}^3$)
OC	6	1/17/01 13:00 – 19:00 PST	3.66	2.75%
OC+EC	6	12/3/00 04:00 – 10:00 PST	5.14	3.65%

6. REFERENCES

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